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Hydrogeochemical signatures of thermal springs compared to deep formation water of North Germany

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Thermal springs and hot deep formation waters can be used for geothermal energy production. Depending on the chemical composition of the used waters, geothermal power plants have to deal with scaling and corrosion effects. Therefore, the understanding of the hydrogeochemical behaviour of such waters can be helpful to enhance the efficiency of the energy production.
This study is comparing hydrogeochemical characteristics of thermal springs in the Harz Mountains (North Germany) and deep formation water of the North German Basin. The Harz Mountains consist of uplifted Palaeozoic rocks, whereas the North German Basin consists of sedimentary layers of Permian, Mesozoic and Cenozoic age. Volcanic rocks are included in the Permian layers. The thickness of the sedimentary basin varies between 2 km and more than 8 km. The deep aquifers of the North German Basin are mostly not involved in the recent meteoric water cycle. Their waters have contents of Total Dissolved Solids (TDS) up to about 400 g/L. Thermal springs of the Harz Mountains are situated close to the main fracture system of the region. These springs are connected to the meteoric water cycle and display lower contents of TDS (< 25 g/L). In both geological systems the TDS content is increasing with depth and temperature. The elemental ratios of the waters (e.g., Na/Cl, Cl/Br, Na/Ca) indicate similar hydrogeochemical formation processes in the Harz Mountains and the North German Basin. The concentrations of calcium, sodium, and chloride differ due to salt dissolution and feldspar transformation (albitisation) in the thermal springs as well as in the deep formation waters. Based on today's knowledge hydrochemical and stratigraphical data from the North German Basin can be used to elucidate the geological origin of the thermal springs in the Harz Mountains.

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